

The Importance of the Omega-6/Omega-3 Fatty Acid Ratio in Cardiovascular Disease and Other Chronic Diseases

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This article contains 134 references

FROM ABSTRACT

Several sources of information suggest that human beings evolved on a diet with a ratio of omega-6 to omega-3 essential fatty acids (EFA) of approximately 1/1, whereas in Western diets the ratio is 15/1 – 16.7/1.

Western diets are deficient in omega-3 fatty acids, and have excessive amounts of omega-6 fatty acids compared with the diet on which human beings evolved and their genetic patterns were established.

Excessive amounts of omega-6 polyunsaturated fatty acids (PUFA) and a very high omega-6/omega-3 ratio, as is found in today's Western diets, promote the pathogenesis of many diseases, including cardiovascular disease, cancer, and inflammatory and autoimmune diseases, whereas increased levels of omega-3 PUFA (a lower omega-6/omega-3 ratio), exert suppressive effects.

In the secondary prevention of cardiovascular disease, a ratio of 4/1 was associated with a 70% decrease in total mortality.

A ratio of 2.5/1 reduced rectal cell proliferation in patients with colorectal cancer, whereas a ratio of 4/1 with the same amount of omega-3 PUFA had no effect.

The lower omega-6/omega-3 ratio in women with breast cancer was associated with decreased risk.

A ratio of 2-3/1 suppressed inflammation in patients with rheumatoid arthritis, and a ratio of 5/1 had a beneficial effect on patients with asthma, whereas a ratio of 10/1 had adverse consequences.

These studies indicate that the optimal ratio may vary with the disease under consideration.

This is consistent with the fact that chronic diseases are multigenic and multifactorial.

Therefore, it is quite possible that the therapeutic dose of omega-3 fatty acids will depend on the degree of severity of disease resulting from the genetic predisposition. A lower ratio of omega-6/omega-3 fatty acids is more desirable in

reducing the risk of many of the chronic diseases of high prevalence in Western societies, as well as in the developing countries.

THIS AUTHOR ALSO NOTES:

“The interaction of genetics and environment, nature, and nurture is the foundation for all health and disease.”

“Genetic factors determine susceptibility to disease and environmental factors determine which genetically susceptible individuals will be affected.”

“Nutrition is an environmental factor of major importance.”

“Whereas major changes have taken place in our diet over the past 10,000 years since the beginning of the Agricultural Revolution, our genes have not changed.”

The spontaneous mutation rate for nuclear DNA is estimated at 0.5% per million years, which means our genes today are very similar to the genes of our ancestors during the Paleolithic period 40,000 years ago.

Humans today live in a nutritional environment that differs from that for which our genetic constitution was selected, particularly in the type and amount of essential fatty acids and in the antioxidant content of foods.

Today’s industrialized societies diets are characterized by

- 1) An increase in calories
- 2) An increase in cereal grains
- 3) An increase in saturated fat
- 4) An increase in trans fatty acids

- 5) A decrease in omega-3 fatty acid intake
- 6) A decrease in complex carbohydrates and fiber
- 7) A decrease in energy expenditure
- 8) A decrease in fruits and vegetables
- 9) A decrease in protein
- 10) A decrease in antioxidants
- 11) A decrease in calcium

“The increase in trans fatty acids is detrimental to health.”

The beneficial health effects of omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are the low rates of coronary heart disease, asthma, type 1 diabetes, multiple sclerosis, cancer, inflammatory bowel disease, rheumatoid arthritis, and psoriasis.

"The rapid changes in our diet, particularly the last 150 years, are potent promoters of chronic diseases such as atherosclerosis, essential hypertension, obesity, diabetes, arthritis and other autoimmune diseases, and many cancers, especially cancer of the breast, colon, and prostate."

The present Western diet is deficient in omega-3 fatty acids with a ratio of omega-6 to omega-3 of 15-20/1, instead of 1/1 as is the case with wild animals and Paleolithic humans.

"An absolute and relative change of omega-6/omega-3 in the food supply of Western societies has occurred over the last 150 years. A balance existed between omega-6 and omega-3 for millions of years during the long evolutionary history of the genus Homo, and genetic changes occurred partly in response to these dietary influences. During evolution, omega-3 fatty acids were found in all foods consumed: meat, wild plants, eggs, fish, nuts and berries."

"Omega-6 and omega-3 fatty acids are essential because humans, like all mammals, cannot make them and must obtain them in their diet."

Omega-6 fatty acids are represented by linoleic acid (LA) and is plentiful in nature, being found in the seeds of most plants except for coconut, cocoa, and palm.

Omega-3 fatty acids are represented by alpha-linolenic acid (ALA), and is found in the chloroplasts of green leafy vegetables, and in the seeds of flax, rape, chia, perilla and walnuts.

EPA and DHA are found in the oils of fatty fish.

Arachidonic (AA) is found predominantly in the phospholipids of grain-fed animals and eggs.

DHA is rich in the cerebral cortex, retina, testis and sperm, and DHA is one of the most abundant components of the brain's structural lipids.

"Mammalian cells cannot convert omega-6 to omega-3 fatty acids because they lack the converting enzyme."

Omega-6 fatty acids and omega-3 fatty acids are metabolically and functionally distinct, and often have important opposing physiological functions.

When humans ingest fish or fish oil, the EPA and DHA from the diet replace the omega-6 fatty acids, especially AA, in the membranes of all cells.

"Because of the increased amounts of omega-6 fatty acids in the Western diet, the eicosanoid metabolic products from AA, specifically prostaglandins, thromboxanes, leukotrienes, hydroxy fatty acids, and lipoxins, are formed in larger

quantities." These eicosanoids from AA contribute to the formation of thrombus and atheromas, to allergic and inflammatory disorders, shifting the physiological state to prothrombotic and increases in blood viscosity, vasospasm, and vasoconstriction.

An omega-6/omega-3 Ratio of 1/1 decreases C-reactive protein.

"The higher the ratio of omega-6/omega-3 fatty acids in platelet phospholipids, the higher the death rate from cardiovascular disease."

"Excessive amounts of omega-6 PUFA and a very high omega-6/omega-3 ratio, as is found in today's Western diets, promote the pathogenesis of many diseases, including cardiovascular disease, cancer, and inflammatory and autoimmune diseases, whereas increased levels of omega-3 PUFA (a lower omega-6/omega-3 ratio), exert suppressive effects."

The total omega-3 fatty acids are associated with lower levels of pro-inflammatory markers and higher anti-inflammatory markers.

"Omega-3 fatty acids are beneficial in patients affected by diseases characterized by active inflammation."

Diets enriched with omega-3 fatty acids reduce levels of omega-6 fatty acids in almost all organs and tissues, including muscles and milk.

Leukotrienes are inflammatory mediators generated from AA by the enzyme 5-lipo-oxygenase. Because atherosclerosis involves arterial inflammation, increased dietary AA significantly enhances atherosclerosis whereas increased dietary intake of omega-3 fatty acids EPA and DHA blunted this effect.

Dietary omega-6 fatty acids promote, whereas omega-3 fatty acids EPA and DHA inhibit leukotriene-mediated inflammation that leads to atherosclerosis.

Olive oil increases the incorporation of omega-3 fatty acids into membranes.

Reducing the ratio to 4/1 of LA/ALA for 2 years decreases total mortality by 70%.

Supplementing with 850 – 882 mg of omega-3 fatty acids at a ratio of 2/1 EPA to DHA decreases sudden cardiac death by 45%.

EPA is a promising treatment for prevention of major coronary events, especially nonfatal coronary events.

Studies show that reducing the levels of omega-6 and increasing the levels of omega-3 fatty acids:
Is antiinflammatory

Is cardioprotective
 Reduces the risk for heart disease
 Reduces the prevalence of non-insulin diabetes mellitus
 Is beneficial for patients with rheumatoid arthritis
 Is beneficial for patients with asthma
 Reduces colorectal cancer risk
 Reduces breast cancer risk
 Reduces the incidence of osteoporosis by helping adolescents establish a better bone mineral base early in life and in preserving skeletal integrity in old age
 Reduces depressive illness
 Reduces the incidence of dry eye syndrome
 Reduces age-related macular degeneration

ARACHIDONIC ACID

20 Carbon Long Omega-6 Fat

↓
COX
Enzymes
↓

SERIES 2
Prostaglandins

↓
LOX
Enzymes
↓

SERIES 4
Leukotrienes

PRO-INFLAMMATORY

ICOSAPENTAENOIC ACID

20 Carbon Long Omega-3 Fat

↓
COX
Enzymes
↓

SERIES 3
Prostaglandins

↓
LOX
Enzymes
↓

SERIES 5
Leukotrienes

ANTI-INFLAMMATORY

“Asthma is a mediator driven inflammatory process in the lungs and the most common chronic condition in childhood. The leukotrienes and prostaglandins are implicated in the inflammatory cascade that occurs in asthmatic airways.” The inflammatory mediators eicosanoids are the products of AA metabolism, and are important mediators in the underlying inflammatory mechanisms of asthma.

“Leukotrienes and prostaglandins appear to have the greatest relevance to the pathogenesis of asthma. The leukotrienes are potent inducers of bronchospasm, airway edema, mucus secretion, and inflammatory cell migration, all of which are important to the asthmatic symptomatology.”

One study concluded “fatty acid levels in breast adipose tissue (which reflect dietary intake) suggest a protective effect of omega-3 fatty acids on breast cancer risk and support the hypothesis that the balance between omega-3 and omega-6 fatty acids plays a role in breast cancer.”

Another study concluded, “Our results support a positive effect of omega-3 fatty acids on breast cancer risk and provide additional evidence for the importance of evaluating the ratio of fatty acids when evaluating diet and breast cancer risk.”

There is a “growing body of evidence that omega-3 fatty acids are beneficial to bone health. Animal models have suggested that omega-3 fatty acids may attenuate postmenopausal bone loss.”

“Psychologic stress in humans induces the production of proinflammatory cytokines. An imbalance of omega-6 and omega-3 PUFA in the peripheral blood causes an overproduction of proinflammatory cytokines. There is evidence that changes in fatty acid composition are involved in the pathophysiology of major depression.”

“Diets with a high omega-6/omega-3 ratio may enhance the risk for both depression and inflammatory diseases.”

Inflammation of the lacrimal gland, the meibomian gland, and the ocular surface plays a significant role in dry eye syndrome. A higher ratio of omega-6/omega-3 consumption is associated with a significantly increased risk of dry eye syndrome.

“Age-related macular degeneration (AMD) is the leading cause of vision loss among people 65 and older,” and ingestion of omega-3 fatty acids reduce the risk of AMD.

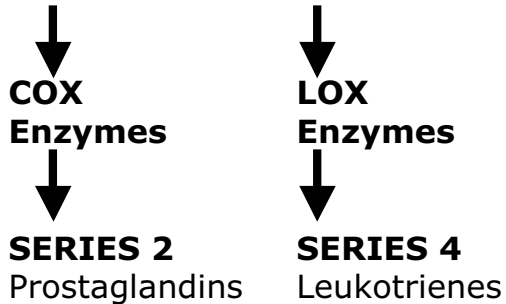
Conclusions and Recommendations

- “Western diets are characterized by high omega-6 and low omega-3 fatty acid intake, whereas during the Paleolithic period when human’s genetic profile was established, there was a balance between omega-6 and omega-3 fatty acids.”
- “Humans today live in a nutritional environment that differs from that for which our genetic constitution was selected.”
- “The balance of omega-6/omega-3 fatty acids is an important determinant in decreasing the risk for coronary heart disease, both in the primary and secondary prevention of coronary heart disease.”
- Increased dietary intake of LA [omega-6 fats from grains and seeds] leads to oxidation of LDL and platelet aggregation. **[Very Important]**
- “Inflammation is at the base of many chronic diseases, including coronary heart disease, diabetes, arthritis, cancer, osteoporosis, mental health, dry eye disease and age-related macular degeneration. Dietary intake of omega-3 fatty acids may prevent the development of disease, particularly in persons with genetic variation.”
- “It is essential to increase the omega-3 and decrease the omega-6 fatty acid intake in order to have a balanced omega-6 and omega-3 intake in the background diet.”

KEY POINTS FROM DAN MURPHY

ARACHIDONIC ACID

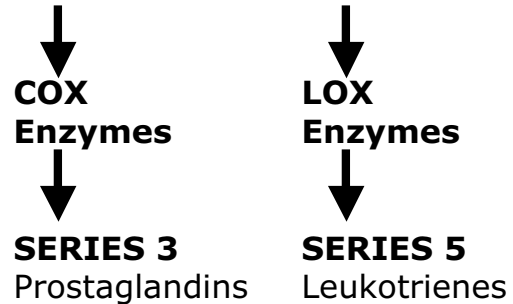
20 Carbon Long Omega-6 Fat



PRO-INFLAMMATORY

EICOSAPENTAENOIC ACID

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ANTI-INFLAMMATORY

- 1) "Human beings evolved on a diet with a ratio of omega-6 to omega-3 essential fatty acids of approximately 1/1, whereas in Western diets the ratio is 15/1 – 20/1."
- 2) "Western diets are deficient in omega-3 fatty acids, and have excessive amounts of omega-6 fatty acids compared with the diet on which human beings evolved and their genetic patterns were established."
- 3) "Excessive amounts of omega-6 polyunsaturated fatty acids (PUFA) and a very high omega-6/omega-3 ratio, as is found in today's Western diets, promote the pathogenesis of many diseases, including cardiovascular disease, cancer, and inflammatory and autoimmune diseases, whereas increased levels of omega-3 PUFA (a lower omega-6/omega-3 ratio), exert suppressive effects."
- 4) The ratio of omega-6/omega-3 should be below 4/1. A ratio of 2.5/1 reduced rectal cell proliferation in colorectal cancer patients, whereas a ratio of 4/1 with the same amount of omega-3 PUFA had no effect. **[Important]**
- 5) A lower ratio of omega-6/omega-3 fatty acids is more desirable in reducing the risk of many of the chronic diseases of high prevalence in Western societies.
- 6) "Genetic factors determine susceptibility to disease and environmental factors determine which genetically susceptible individuals will be affected." "Nutrition is an environmental factor of major importance."
- 7) The spontaneous mutation rate for nuclear DNA is estimated at 0.5% per million years, which means our genes today are very similar to the genes of our ancestors during the Paleolithic period 40,000 years ago.

- 8) Humans today live in a nutritional environment that differs from that for which our genetic constitution was selected, particularly in the type and amount of essential fatty acids and in the antioxidant content of foods. Today's industrialized societies diets are characterized by
- A)) An increase in calories
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 - E)) A decrease in omega-3 fatty acid intake
 - F)) A decrease in complex carbohydrates and fiber
 - G)) A decrease in energy expenditure
 - H)) A decrease in fruits and vegetables
 - I)) A decrease in protein
 - J)) A decrease in antioxidants
 - K)) A decrease in calcium
- 9) "The increase in trans fatty acids is detrimental to health."
- 10) The beneficial health effects of omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are low rates of coronary heart disease, asthma, type 1-diabetes, multiple sclerosis, cancer, inflammatory bowel disease, rheumatoid arthritis, and psoriasis.
- 11) "The rapid changes in our diet, particularly the last 150 years, are potent promoters of chronic diseases such as atherosclerosis, essential hypertension, obesity, diabetes, arthritis and other autoimmune diseases, and many cancers, especially cancer of the breast, colon, and prostate."
- 12) The present Western diet is deficient in omega-3 fatty acids with a ratio of omega-6 to omega-3 of 15-20/1, instead of 1/1 as is the case with wild animals and Paleolithic humans.
- 13) "An absolute and relative change of omega-6/omega-3 in the food supply of Western societies has occurred over the last 150 years. A balance existed between omega-6 and omega-3 for millions of years during the long evolutionary history of the genus Homo, and genetic changes occurred partly in response to these dietary influences. During evolution, omega-3 fatty acids were found in all foods consumed: meat, wild plants, eggs, fish, nuts and berries."
- 14) "Omega-6 and omega-3 fatty acids are essential because humans, like all mammals, cannot make them and must obtain them in their diet."
- 15) Omega-6 fatty acids are represented by linoleic acid (LA) and is plentiful in seeds and grains.

- 16) Omega-3 fatty acids are represented by alpha-linolenic acid (ALA), and is found in the chloroplasts of green leafy vegetables, and in the seeds of flax, rape, chia, perilla and in walnuts.
- 17) EPA and DHA are found in the oils of fatty fish.
- 18) AA is found predominantly in the phospholipids of grain-fed animals and eggs.
- 19) DHA is one of the most abundant components of the brain's structural lipids.
- 20) When humans ingest fish or fish oil, the EPA and DHA from the diet replace the omega-6 fatty acids, especially AA, in the membranes of all cells.
- 21) "Because of the increased amounts of omega-6 fatty acids in the Western diet, the eicosanoid metabolic products from AA, specifically prostaglandins, thromboxanes, leukotrienes, hydroxy fatty acids, and lipoxins, are formed in larger quantities." These eicosanoids from AA contribute to the formation of thrombus and atheromas, to allergic and inflammatory disorders, shifting the physiological state to prothrombotic and increases in blood viscosity, vasospasm, and vasoconstriction.
- 22) An omega-6/omega-3 Ratio of 1/1 decreases C-reactive protein.
- 23) "The higher the ratio of omega-6/omega-3 fatty acids in platelet phospholipids, the higher the death rate from cardiovascular disease."
- 24) "Excessive amounts of omega-6 PUFA and a very high omega-6/omega-3 ratio, as is found in today's Western diets, promote the pathogenesis of many diseases, including cardiovascular disease, cancer, and inflammatory and autoimmune diseases, whereas increased levels of omega-3 PUFA (a lower omega-6/omega-3 ratio), exert suppressive effects."
- 25) The total omega-3 fatty acids are associated with lower levels of pro-inflammatory markers and higher anti-inflammatory markers.
- 26) Increased dietary AA significantly enhances atherosclerosis whereas increased dietary intake of omega-3 fatty acids EPA and DHA blunted this effect.
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- 28) Olive oil increases the incorporation of omega-3 fatty acids into membranes.
- 29) Reducing the ratio to 4/1 of LA/ALA for 2 years decreases total mortality by 70%.
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31) EPA is a promising treatment for prevention of major coronary events, especially nonfatal coronary events.

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Reduces colorectal cancer risk

Reduces breast cancer risk

Reduces the incidence of osteoporosis by helping adolescents establish a better bone mineral base early in life and in preserving skeletal integrity in old age

Reduces depressive illness

Reduces the incidence of dry eye syndrome

Reduces age-related macular degeneration

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37) "Psychologic stress in humans induces the production of proinflammatory cytokines. An imbalance of omega-6 and omega-3 PUFA in the peripheral blood causes an overproduction of proinflammatory cytokines. There is evidence that changes in fatty acid composition are involved in the pathophysiology of major depression."

38) "Diets with a high omega-6/omega-3 ratio may enhance the risk for both depression and inflammatory diseases."

- 39) Inflammation of the lacrimal gland, the meibomian gland, and the ocular surface plays a significant role in dry eye syndrome. A higher ratio of omega-6/omega-3 consumption is associated with a significantly increased risk of dry eye syndrome.
- 40) "Age-related macular degeneration (AMD) is the leading cause of vision loss among people 65 and older," and ingestion of omega-3 fatty acids reduce the risk of AMD.
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- 44) "It is essential to increase the omega-3 and decrease the omega-6 fatty acid intake in order to have a balanced omega-6 and omega-3 intake in the background diet."